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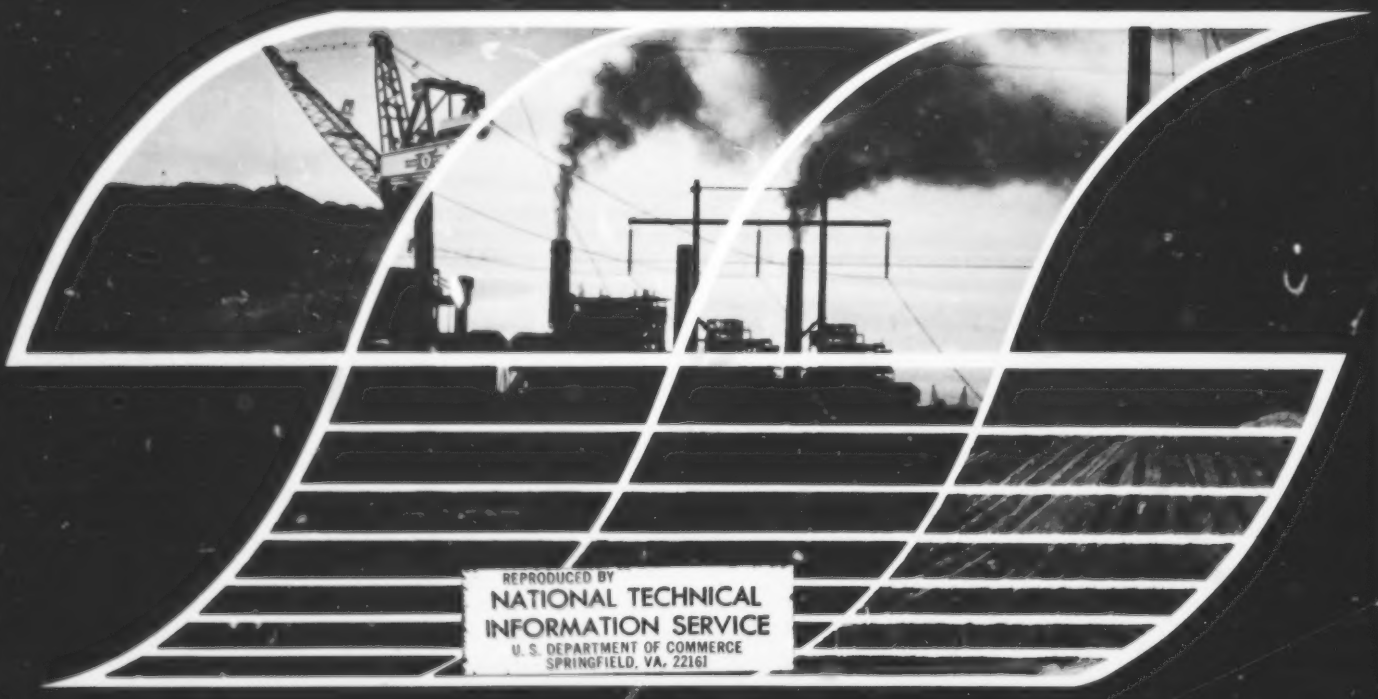
Interagency Energy/Environment R&D Program



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THE ENERGY/ENVIRONMENT R&D Decision Series

This volume is a part of the Energy/Environment R&D Decision Series. The series presents the key issues and findings of the 17-agency Federal Interagency Energy/Environment Research and Development Program in a format conducive to efficient information transfer. The volumes are of three types: Summaries—short synopses of larger research reports; Issue Papers—concise discussions of major energy/environment technical issues; and Executive Reports—in-depth discussions of an entire programmatic or technical area.

The Interagency Program was inaugurated in fiscal year 1975. Planned and coordinated by the Environmental Protection Agency (EPA), research projects supported by the program range from the analysis of health and environmental effects of energy systems to the development of environmental control tecnologies. The works in this series will reflect the full range of program concerns.

The Decision Series is produced for both energy/environment decision-makers and the interested public. If you have any suggestions, comments, questions or topics you would like to see discussed, please write to Series Editor Richard Laska, Office of Energy, Minerals and Industry, RD-681, U.S. EPA, Washington, D.C. 20460 or call (202) 755-4857. Extra copies are available on request.

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16. ABSTRACT

This volume is a part of the Energy/Environment R&D Decision Series. The series presents the key issues and findings of the 17-agency Federal Interagency Energy/Environment Research and Development in a format designed for the lay public. The volumes are of three types: Summaries-short synopses of larger research reports; Issue Paper-concise discussions of major energy/environment technical issues; and Executive Reports- in-depth discussions of an entire programmmatic or technical area. The Interagency Program was inaugurated in fiscal year 1975. Planned and coordinated by the Environmental Protection Agency, research projects supported by the program range from the analysis of health and environmental effects of energy systems to the development of environmental control technologies. The works in this series will reflect the full range of program concerns.

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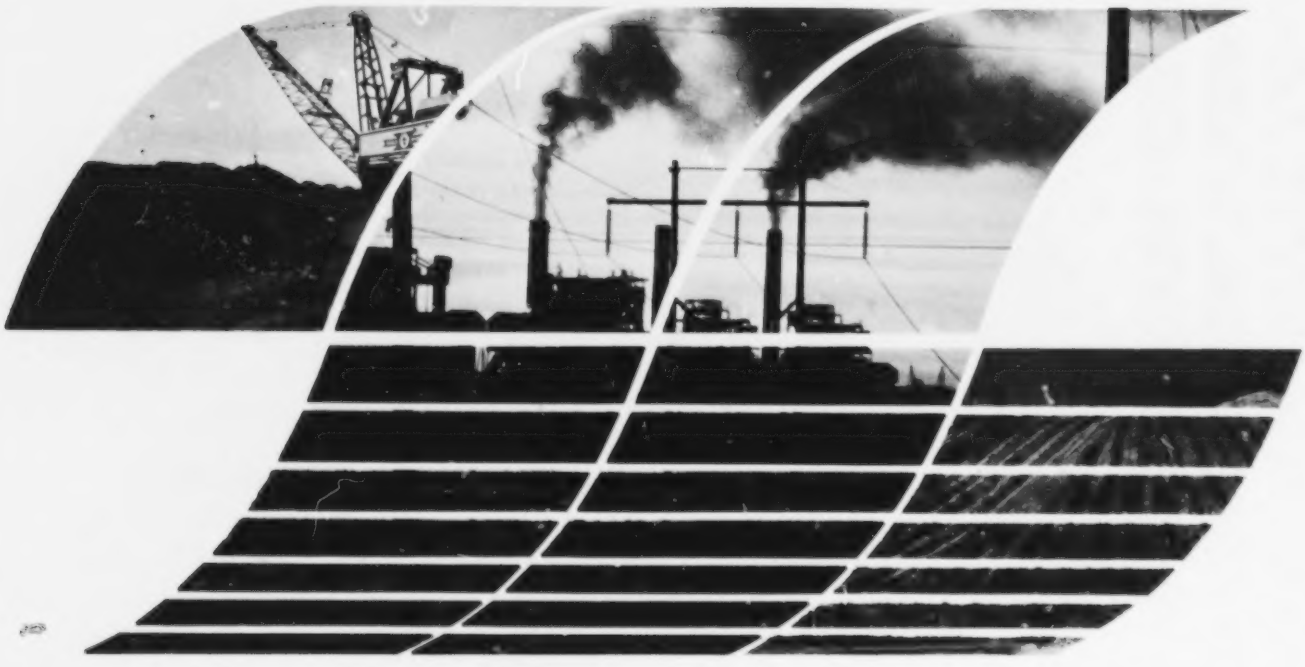


Agencies and Project Examples of the

DEPARTMENT OF AGRICULTURE

Agricultural Research Service

Use of Waste Material to Revegetate Strip Mined Areas

Control Instability in Mine Areas

Cooperative State Research Service

Determine Levels and Quality of Groundwater in Areas Affected by Mining

Economic Research Service

Assess Impact of Energy Development in Northern Great Plains on Employment Income, Population and Local Government

Forest Service

Develop Guidelines for Revegetation of Coal and Oil Shale Mined Areas

Soil Conservation Service

Develop Techniques for Planting to Reduce Erosion and Reclaim Mined Areas

DEPARTMENT OF COMMERCE

National Bureau of Standards

Develop Energy-Related Air and Water Pollutant Standard Reference Materials

National Oceanic and Atmospheric Administration

Meteorological Interpretation and Prediction of Air Quality in Energy Development Areas

Office of Environmental Affairs

Assess Overall Impact of Energy Development

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Identify Physiologically Detrimental Agents Resulting from Major Fossil Fuel Extraction and Conversion Technologies

Develop Control Technology for Fluidized Bed Combustion and Synthetic Fuel Processes

FEDERAL ENERGY ADMINISTRATION

Assess the Overall Impact on Air Quality of Alaskan Oil Development

Energy/Environment R & D Program

ENVIRONMENTAL PROTECTION AGENCY

Perform Overall Integrated Technology Assessment for Western Energy Development

Develop Environmental Controls for Coal Cleaning, Fluidized Bed Combustion, Synthetic Fuels, and Waste-as-Fuel Processes

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

National Institute of Environmental Health Sciences

Identify the Effects on Cells and Cell Components of Pollutants from Energy Technologies

National Institute of Occupational Safety and Health

Assess the Human Health Effects of Occupational Exposure to Energy Technologies

TENNESSEE VALLEY AUTHORITY

Demonstrate Regenerable and Non-Regenerable Flue Gas Desulfurization Technology

Develop Byproduct Uses and Disposal Methods for Treatment Wastes

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Assess the Socioeconomic Impact of Energy Conservation on the Residential Sector

DEPARTMENT OF THE INTERIOR

Bureau of Mines

Develop and Demonstrate a Coal Washing Test Facility

Fish and Wildlife Service

Prepare Comprehensive Reports on Coastal Areas Subject to Energy Development with Emphasis on Fish, Wildlife, and Ecological Processes

Geological Survey

Monitor Surface Water and Groundwater Quality in Western Energy Development Regions

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Develop Instrumentation for Remote Environmental Monitoring in Energy Development Areas

Introduction

Energy is everywhere. It surrounds us. We're familiar with jet airplanes and buses and homes full of appliances. We can cook a meal at an instant's notice. We can hop into a car and be moving 50 miles an hour in a matter of seconds. Energy is everywhere to serve us. It is part of our environment.

Although it *is* everywhere, energy is not naturally in the forms in which we use it. In our natural environment, energy comes from the sun, or from plants, or animals, or falling water, or the food that gives us the energy to do what we wish. It doesn't come from a pump, or a plug, or a dial on the stove, or a thermostat on the wall. The forms of energy to which we are most accustomed are not *natural* forms, but are *processed* forms. They are processed to convert or transform naturally-occurring forms of energy into forms more convenient for us to use. Unfortunately, in our efforts to concentrate and make convenient our energy supply, we do serious damage to our environment. For example, to make electricity for our appliances, we dig up thousands of acres of coal. In some areas that were mined for coal half a century ago, the land has not yet recovered, and may be scarred forever.

But the mining of coal is only the beginning of our environmental problems.

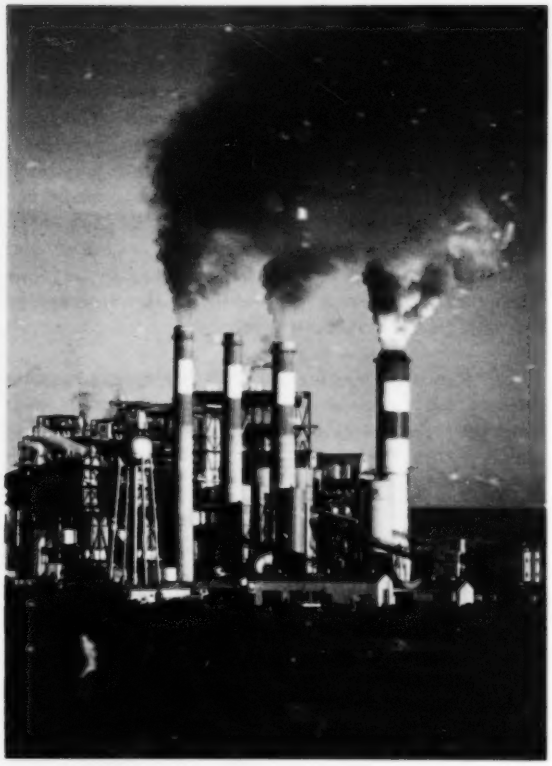
The coal is then burned for heat to drive our industries and to generate electricity. In burning the coal, we release not only heat but many chemical substances which were trapped in the coal when it was formed millions of years ago. Perhaps the most troublesome of these substances is sulfur. With some domestic coals, if you burn a ton of coal you release about 50 pounds of sulfur into the atmosphere. And a large power plant can burn more than 6,000 tons of coal every day which could release over 150 tons of sulfur to the atmosphere. The sulfur is released in the form of compounds which have been proven to have dangerous effects on human health as well as on the natural environment.

As a result, whenever our common domestic energy resources are used, we pay a price in environmental damage. And, more and more of our domestic energy supplies, especially coal, are going to be used if we are to succeed in becoming less dependent on foreign energy sources.

DEVELOPING DOMESTIC ENERGY

The Nation is committed to developing domestic resources—coal, oil and natural gas, nuclear, solar, and geothermal—and to a program of energy conservation. At the same time, we as a nation are equally committed to avoiding the widespread environmental damage which too often, in the past, has accompanied energy resource development.

In 1973, two Federal interagency task forces representing 23 departments and agencies were established to develop programs to meet both goals—energy development and environmental protection. From these task forces, the Federal Interagency Energy/Environment Research and Development Program has evolved. This Program established a lasting mechanism that plans, coordinates, and funds research and development (R&D) on clean energy use and pollution control technology activities within the participating governmental agencies.



The United States is committed to rapid energy development at a minimal environmental cost. To achieve this goal, an extensive research program has been initiated. A large portion of the research relating to the environmental aspects of energy development is centralized in the Interagency Energy/Environment Research and Development Program. These efforts are both interagency and centralized for three reasons. First, since the research is conducted by 17 different Federal agencies and departments, those organizations with expertise in a particular research area are able to concentrate their research in that area. This helps assure an efficient use of Federal research dollars. Second, central planning helps assure that research gaps are filled and that research overlaps are minimized. Third, central coordination helps assure that the results of all the research efforts are communicated both to the general public and to the research community.

Overall coordination and detailed planning of the Interagency Energy/Environment Program is the responsibility of the Office of Energy, Minerals and Industry within the Environmental Protection Agency's (EPA) Office of Research and Development. R&D activities under this program are performed by several Federal agencies in addition to the EPA. The overall effort is divided into two major programs which address:

- **Process and Effects**, including effects on human health, ecology, the movement of pollutants through the environment (dissemination), their ultimate fate, and integrated assessment (which ties together all of the information available on a particular energy/environment technology).

- **Control Technology**, including control measures as well as modifications to conventional processes for energy extraction, conversion or use.

Program Purpose

The more energy we create and use within our boundaries, the more burdensome our pollution load will become. Expansion of existing energy supplies and development of new energy sources require accelerated efforts to anticipate, plan for, and control the resultant adverse health and ecological effects.

Since its establishment in 1970, the Environmental Protection Agency has been involved in energy-related environmental research efforts, including the development of pollution control technology. To meet its legal responsibilities, EPA established research programs on removing sulfur from power plant flue gas, energy recovery from municipal waste, fluidized bed combustion (a cleaner and more efficient way to burn coal and petroleum residue), synthetic fuels, physical and chemical coal cleaning (pre-combustion), health and ecological effects of energy-related pollutants, and pollutant measurement and monitoring techniques.

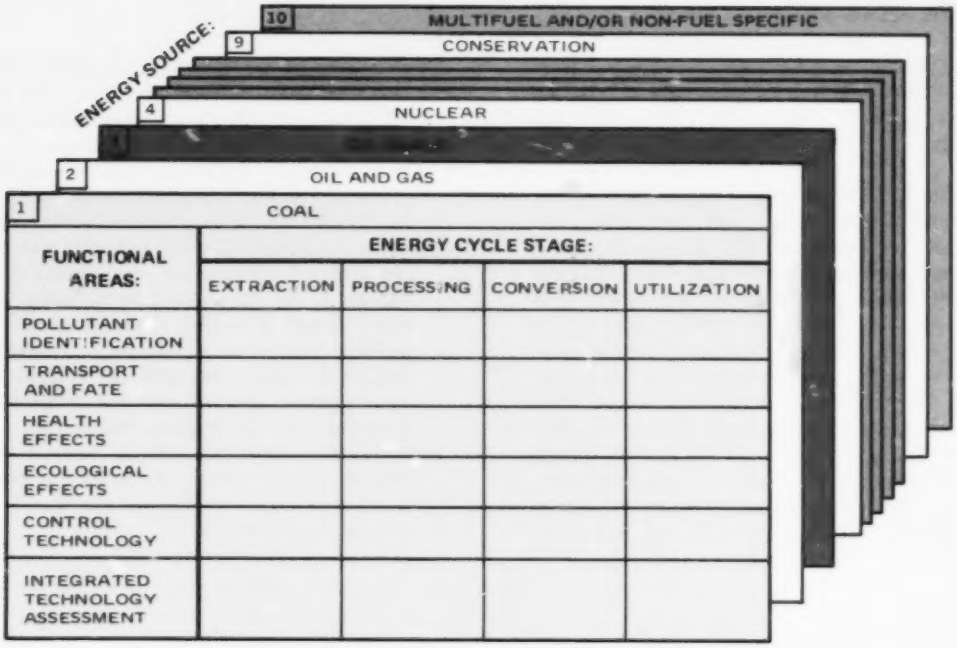
The national policy emphasis on development of domestic energy supplies stimulated the formation by EPA, in late 1974, of an Office of Energy Research (OER) within the Office of Research and Development (ORD). Subsequently, in June of 1975, industrial and mineral extraction pollution control research was combined with energy-related environmental research in a new Office of Energy, Minerals and Industry (OEMI).

OEMI pursues two basic purposes—to provide a focus for EPA's own Energy/Environment/Industry R&D efforts and to serve as the coordinator of the Federal Interagency Energy/Environment R&D Program. This goal includes environmental protection during every phase of development and use of domestic energy supplies, as well as the development of cost-effective pollution control technologies for energy systems.

COORDINATED R&D

The philosophy behind the Interagency Program recognizes that continuity is crucial in a successful R&D effort. Often, the "surge effect" of accelerated R&D in response to a new problem can lead to significant waste of both time and resources. The nature of energy/environment research requires systematically structured, comprehensively designed programs so that long-range effects and unexpected problems or developments can be assessed adequately. Within the agencies involved in the program, there lies a reservoir of expertise and experience which could not be mobilized by any one agency. This resource can, through the Interagency Program, be used most effectively.

EPA's role as coordinator of the Interagency Program reflects the need for a sound environmental R&D program to be conducted in parallel with the evolving energy development programs of the Energy Research and Development Administration (ERDA). ERDA's mission is to aggressively pursue new energy sources and to expand existing sources using the best technological, economic, and environmental means available. Because of the pressure to develop new energy sources and technologies, ERDA cannot be expected to focus as intensely on the environmental aspects as it does on its primary energy development responsibilities. EPA's primary mission is environmental protection, and its objective in the energy area is to enable ERDA's efforts to progress as rapidly as possible while assuring that national environmental goals are maintained. Through this division of effort there develops a healthy, creative tension between the two agencies to ensure well-supported planning and strategy decisions.



INTERAGENCY PROGRAM PLANNING ST[illegible]

Congress was cognizant of these two complementary roles when it enacted the Energy Reorganization Act of 1974, under which ERDA was established. This Act calls on the directors of EPA and ERDA to formulate interagency agreements to promote cooperative Federal Energy/Environment R&D efforts. This diversity established by Congress should help to ensure balanced, objective, and carefully weighed judgments. Greater protection of the public interest resulting from such a balancing process should foster public trust and increase confidence in national energy and environmental policy decisions.

The above chart shows how more than 300 major projects in the Interagency R&D Program are organized. Within this planning structure, all ongoing or future projects can be quickly reviewed in terms of the energy source involved (coal, nuclear, conservation, etc.), the energy cycle component (extraction, processing, use, etc.), and the functional area (health effects, control technology, etc.). Such a structure is used both to stimulate effective communication between researchers involved in related areas and to help assure a balanced and complete research program.

Program Purpose

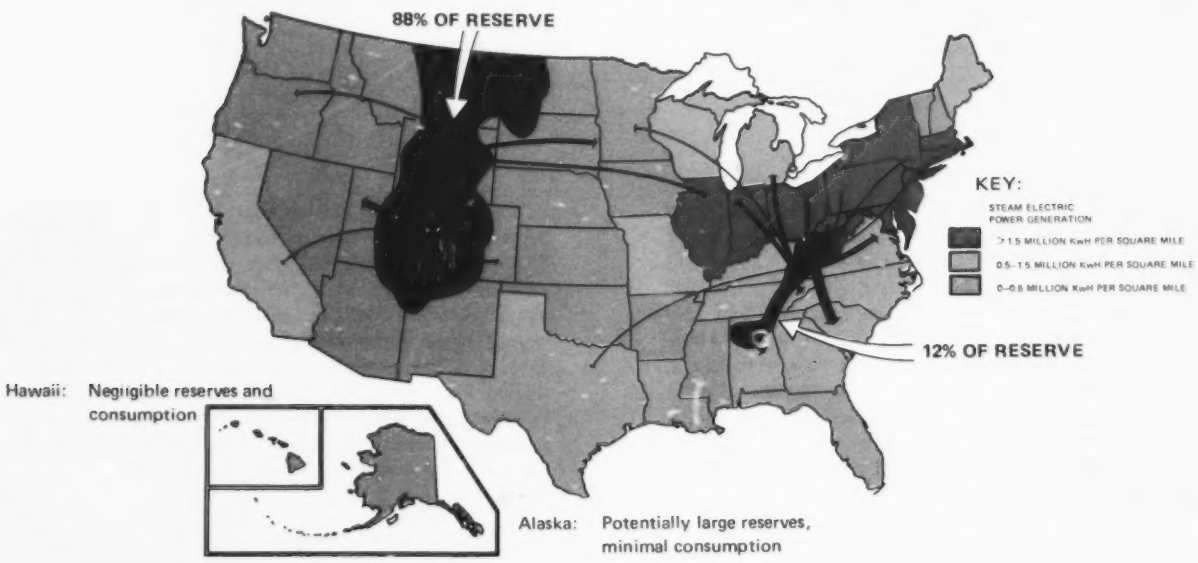
COAL—OUR NEAR-TERM ANSWER

In general, efforts to expand use of domestic energy supplies will focus on two of the Nation's primary resources for meeting future energy needs—coal and nuclear energy.

Through the 1970's and early 1980's, however, only coal use can be increased to an appreciable extent. But increased coal use can occur only if technologies to control emissions of sulfur oxides and other pollutants are successfully applied. To the degree that these control technologies can be implemented rapidly, there will be early environmental, economic, and social benefits from R&D efforts to control such pollutants. For this reason, funds were weighed heavily in the 1975 and 1976 budgets toward facilitating near-term coal use: development of flue gas desulfurization systems, analysis and control of environmental effects from coal extraction, characterization and monitoring of resultant pollutants, and determination of health effects of coal conversion processes.

A complicating factor in our ability to use coal as a near-term answer to energy needs involves distribution of the resource. The map shown below identifies where our coal reserves are located and where our total energy is consumed for electric power. Most of the new, lower sulfur coal that can be produced in the near future is in the Rocky Mountain and Northern Great Plains provinces. Ironically, most of the electric power generation is not here, but rather in the Northeastern and Great Lakes regions. If the new coal is to be useful in the regions where energy is needed, then additional action will be required beyond mining the coal. The coal itself will be shipped to the power plants, the coal will be converted to a liquid or gaseous fuel for delivery to the power plants, or new power plants will be built where the coal is and the electricity will be transmitted where it is needed. In any of these options R&D is required through the Interagency Program to minimize environmental damage which may result.

LOW SULFUR COAL RESERVES VS. STEAM ELECTRIC POWER GENERATION


88% OF RESERVE
KEY:
STEAM ELECTRIC POWER GENERATION
> 1.5 MILLION KwH PER SQUARE MILE
0.5–1.5 MILLION KwH PER SQUARE MILE
0–0.5 MILLION KwH PER SQUARE MILE
12% OF RESERVE
Hawaii: Negligible reserves and consumption
Alaska: Potentially large reserves, minimal consumption

OTHER POTENTIAL SOURCES

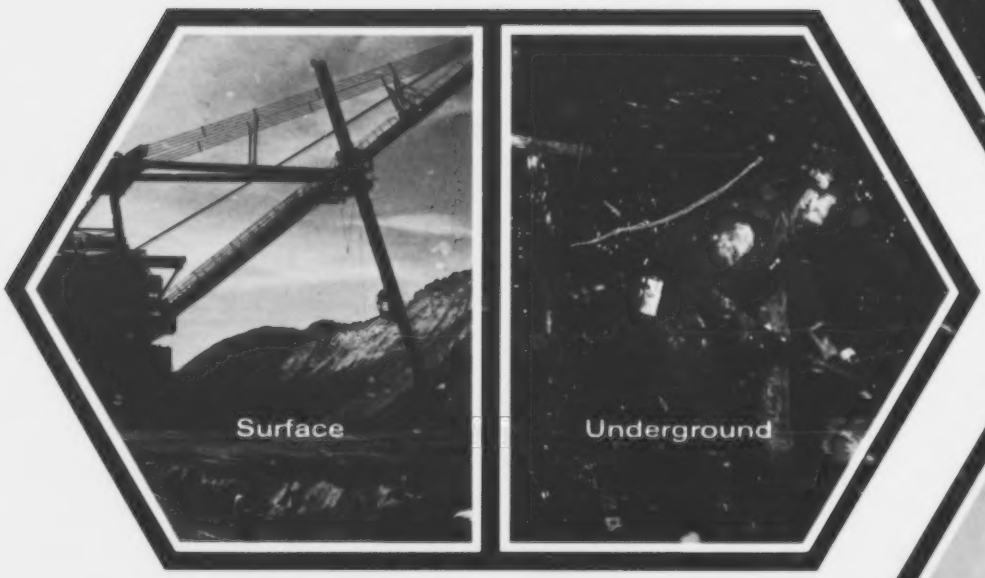
Oil Shale sources which could be developed in the near future are located in the western states (as was the case with the low sulfur coal). Major problems with oil shale development include high cost of oil recovery and large volume of waste shale to be disposed of. Eastern shale deposits (light gray tint) are of lower quality and are not economically recoverable under present conditions.

Geothermal resource reserves are generally located west of the Rocky Mountains. Geothermal energy may be very advantageous in some specific areas, but many unique technological and environmental problems remain to be solved before this source will make significant contributions toward providing clean energy.

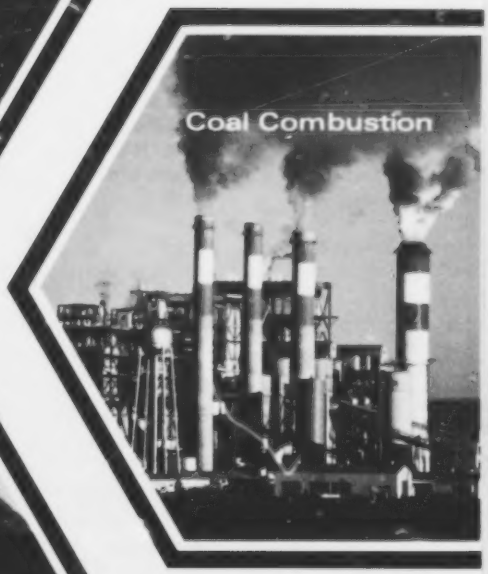
Offshore Oil and Gas areas are estimated to contain considerable undeveloped reserves, mainly along the east and gulf coasts. Accidents during exploration, drilling, and production and leaks and spills during transportation have a large potential adverse impact on marine and coastal ecosystems. Such coastal areas spawn approximately two-thirds of our commercial fish products, and must be protected.

ENERGY/ENVIRONMEN

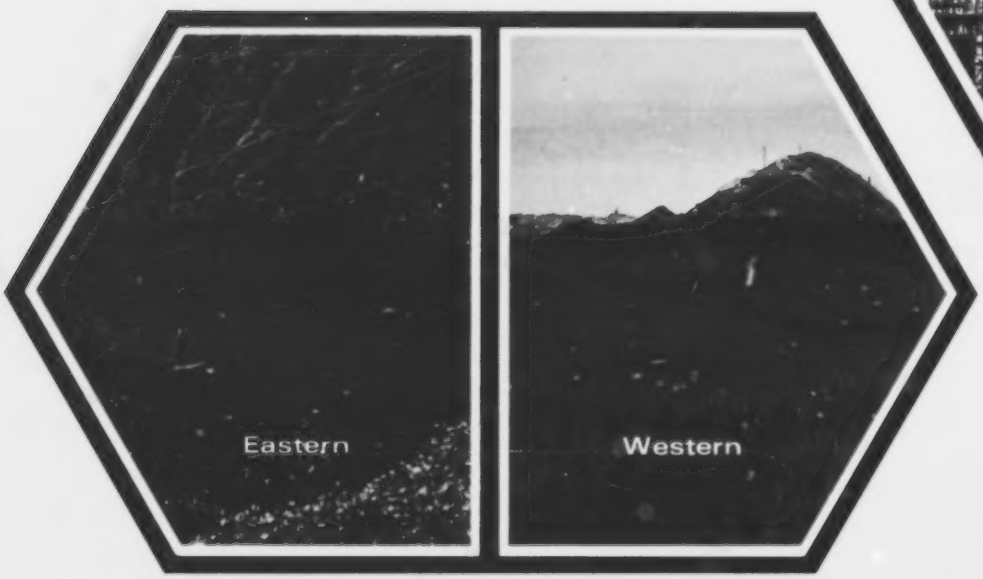
Air Pollut



Coal Extraction



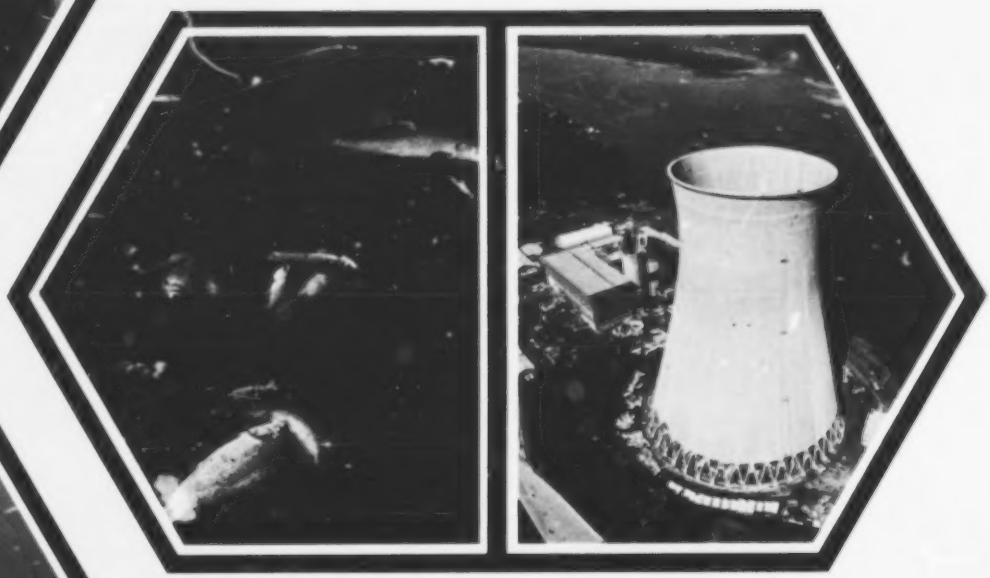
Energy C



Land Reclamation

T: THE COAL EXAMPLE

n Control



Water Pollution Control

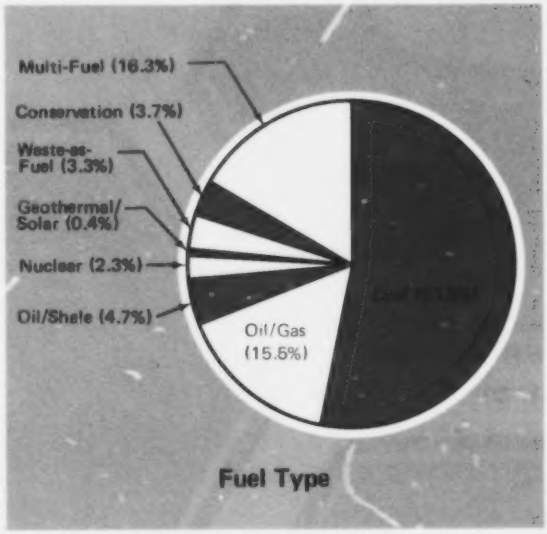
eneration

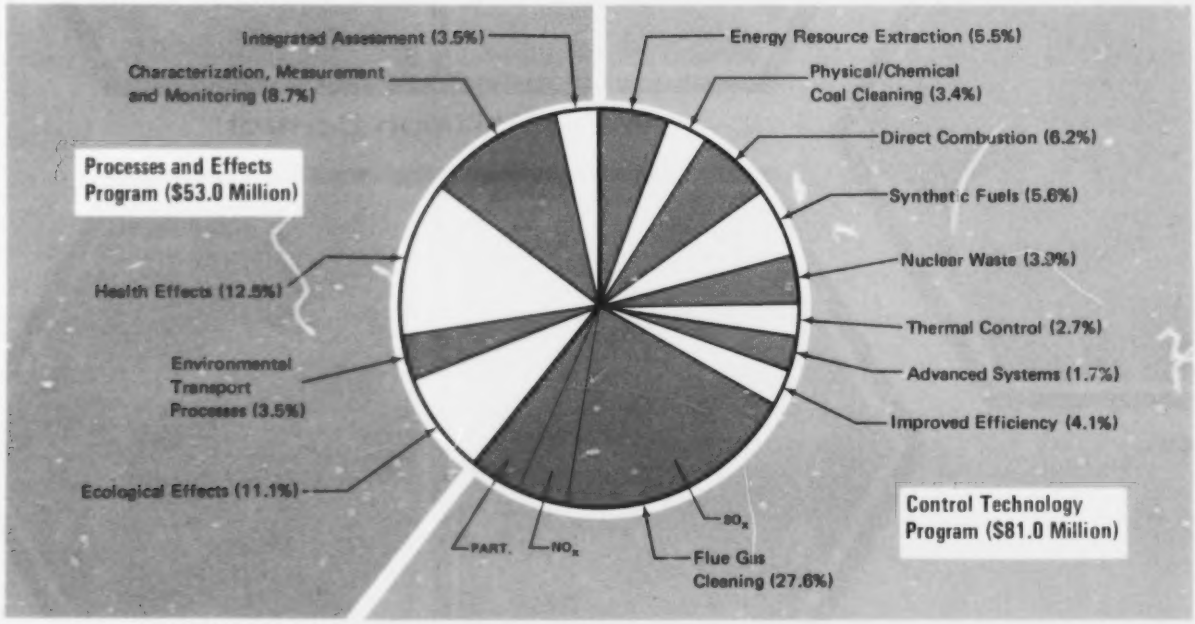
Integrated Assessment

Program History

1975 BUDGET

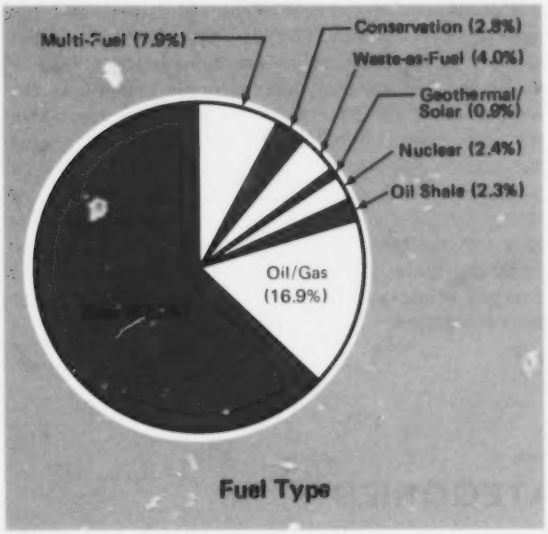
The Federal energy/environment budget requests for Fiscal Year (FY) 1975 contained a substantial increase in energy-related environmental R&D. The administration, through EPA's budget, requested $191 million in FY 1975 for the Energy/Environment R&D Program. Congress authorized $134 million. Of this total, EPA transferred approximately $53 million, or nearly 40 percent, to other agencies for implementation.

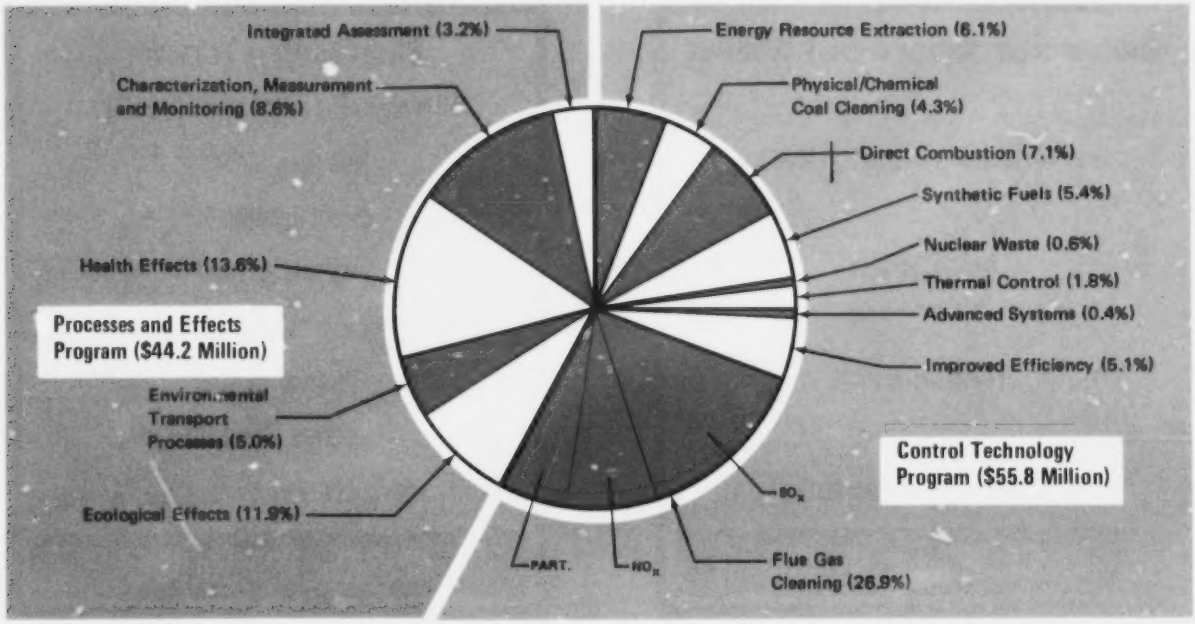




1976 BUDGET

For FY 1976, EPA's budget requested $112 million for the Energy/Environment R&D Program. Congress appropriated $100 million. The interagency portion of the program is about $34 million. Part of the reduction is associated with direct appropriation to ERDA of $6 million of their Interagency Program allocation. Another part is associated with the full funding, in FY 1975, by EPA of two large flue gas desulfurization demonstrations that accounted for a large part of the FY 1975 budget.





The Program Today

The Interagency Program as it exists today is based upon the Presidentially-mandated report *The Nation's Energy Future* (often referred to as the Ray Report), and on the two Federal task forces formed to develop implementing recommendations based on the Ray Report. The two interagency task forces were formed by the White House Office of Management and Budget under direction of the Council on Environmental Quality. They divided their effort between an examination of the health and environmental effects of energy use, and pollutant control technology for energy systems. Their reports recommended federal funding in these two areas which would result in closing existing research gaps while at the same time eliminating duplication of effort by several agencies.

Results of Task Force recommendations and the planning and coordination by EPA with the other agencies in the Program are becoming evident. One of the most fundamental, but necessary, results is the acceptance of the interagency project categories which are now used by EPA and ERDA and are being increasingly put into use by the other agencies. These 14 categories, which come under the general headings of either *Process and Effects* or *Control Technology*, are shown in the table. Projects underway in each of these categories have already shown the success of the Energy/Environment R&D Program, and several of these deserve mention.

INTERAGENCY CATEGORIES

PROCESSES and EFFECTS	CONTROL TECHNOLOGY
Characterization, Measurement & Monitoring	Energy Resource Extraction
Environmental Transport Processes	Physical/Chemical Coal Cleaning
Health Effects	Flue Gas Cleaning
Ecological Effects	Direct Combustion
Integrated Assessment	Synthetic Fuels
	Nuclear Waste Control
	Thermal Control
	Improved Efficiency
	Advanced Energy Systems

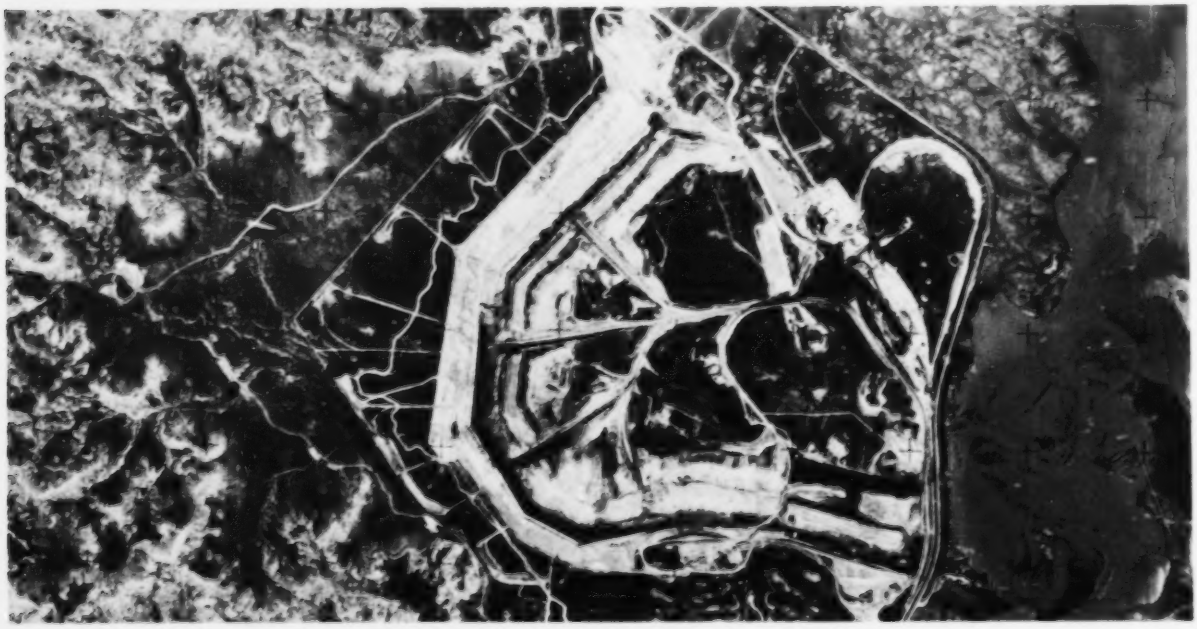
PROCESS AND EFFECTS

Environmental process and effects R&D includes efforts to determine what is a pollutant, how it travels through the environment, how much of it is present, at what level is it dangerous to humans and to other living things, and what is its overall impact on all segments of the energy/environment complex.

The Interagency Program supports R&D to provide the answers to these questions, as the following examples in each interagency category show:

Characterization, Measurement and Monitoring—The government's commitment to developing domestic energy resources in the near future means, to a great extent, the development of western coal reserves. It is not surprising, therefore, that a major part of the Interagency Program's monitoring R&D effort is targeted at the western U.S. In nine western states EPA, the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration have joined forces to monitor air and water quality and land-use patterns in the western energy development areas. This comprehensive monitoring effort is providing a vast store of knowledge of existing environmental conditions in those areas where energy development and processing is most likely to occur. With this knowledge, the agencies in the Energy/Environment Program will be able to plan for energy development with minimal impact on nearly pure air, clean but scarce water supplies, and existing land use patterns. With this base of data, even the more subtle energy development environmental impacts should be identifiable.

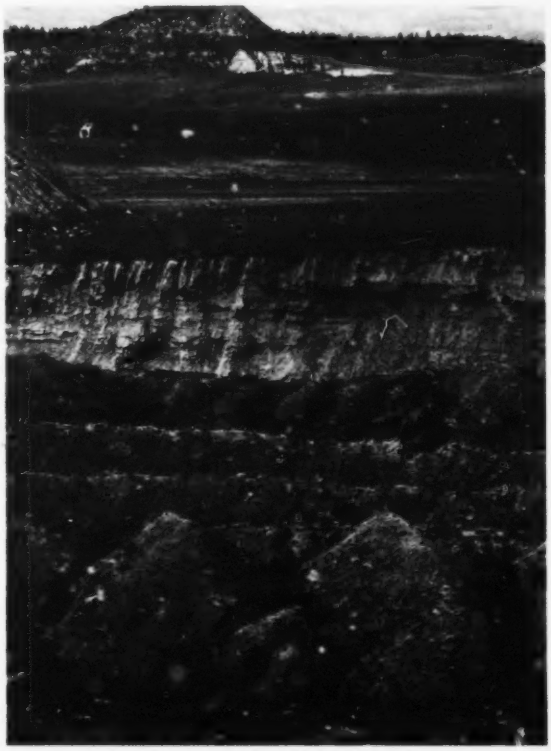
The photograph below was taken by a NASA aircraft at 55,000 feet. Through special color processes, such pictures provide dramatic contrasts between different land uses. This photograph shows strip mining for coal in Montana, with mined areas and roads in white, and natural vegetation and reclaimed areas in red. Such overhead monitoring is proving useful in the vast areas of the west where energy development is occurring.



The Program Today

Environmental Transport Processes—While domestic coal may be the main answer to increased energy production in the near future, combustion of coal produces environmental problems as well as energy. Sulfates are viewed as a major health hazard, and the source of sulfates is strongly suspected to be atmospheric reaction of sulfur dioxide from coal-fired power plants. However, since billions of dollars are at stake in the control of sulfates, strong suspicion will not suffice. The *Midwest Interstate Sulfur Transformation and Transport Study* is one of the Energy/Environment Program's efforts to determine how sulfates form, how they travel, and what is the most effective means for their control. With data obtained in the St. Louis area, the study has been able to make determinations which eventually will lead to a full understanding of sulfates and allow implementation of cost-effective, scientifically defensible controls.

Health Effects—Under the umbrella of the Interagency Program, EPA, the Energy Research and Development Administration, the National Institute of Environmental Health Sciences, and the National Institute of Occupational Safety and Health are all involved in a broad spectrum of complementary Energy/Environment Program projects dealing with the effects of energy development and use on human health. As may be expected, the major emphasis is on the health effects caused by coal extraction, combustion, and new conversion technologies. Much of the R&D involves investigations of potential cancer-causing substances which must be controlled in new coal technologies.



Ecological Effects—Eleven agencies in the Energy/Environment Program are involved in R&D on the effects of energy development and use on crops, plants, wildlife, and natural habitats. These studies range from the future of our coastal wetlands to impacts on high mountain streams and western deserts. Several good examples of on-going Interagency Program research efforts relate to potential energy-related environmental problems in ocean, coastal and estuarine ecosystems. These projects are being conducted by EPA, ERDA, the Fish and Wildlife Service (USFWS), the National Institute of Environmental Health Sciences (NIEHS), and the National Oceanic and Atmospheric Administration (NOAA). The goal of this research is to assure the protection of the sensitive coastal regions of the country—regions which spawn about two-thirds of our commercial fish catch—from serious disruption caused by offshore, coastal or inland energy-related development.

To support this goal, one research project involves the development of an accurate model of an ocean/estuarine ecosystem. Such a model will allow the testing of the effects of various energy-related pollutants on marine organisms. Other projects aim at determining how energy-related pollutants, such as power plant ash and sludge, will affect the ocean food chain, and at determining what the combined impacts will be of changes in

temperature and metal content. Tying these and several other projects together are the total ecological assessments being conducted in the Nation's most important coastal and estuarine areas.

Integrated Assessment—In the above discussions of projects in the Process and Effects part of the Energy/Environment Program, it is clear that one project category overlaps into the next and that all are really interrelated. This inevitable interdependency is recognized in a final project category, wherein the agencies involved in the Energy/Environment Program are working to take all factors into account, put all the pieces together, and map out the best way to proceed toward the compatible goals of energy development and environmental protection. Three of the major projects in this area are the assessment of western energy resource development, energy resource development in the Ohio River Basin, and nationwide expansion of coal-fired electric power plants. All of these projects take into account energy requirements and availability, land-use patterns and resource availability (especially water in western coal regions), socioeconomic impact, and cultural and aesthetic sacrifices that may result.

CONTROL TECHNOLOGY

The general heading of Control Technology R&D includes the nine specific activity categories listed earlier. The major emphasis here, as with Process and Effects R&D, is on domestic coal. Accordingly, the nine Control Technology categories have been grouped into six major project areas related to coal production and utilization. Coal is our most abundant energy resource but, without adequate controls, its development can also be most detrimental to our environment.

While fine particles and hazardous trace elements create problems in coal production and burning, the main concern to date has been sulfur compounds. When these compounds are burned, they produce sulfur dioxide and sulfates, which, when breathed, are hazardous to human health. If the abundant coal is to be used, the sulfur must first be controlled. The Energy/Environment program has proceeded with R&D on several approaches to control sulfur from coal use.

Energy Extraction—One of the first ways of controlling sulfur in coal is to mine the coal that's lowest in sulfur content in its natural state. The largest amounts of that kind of coal are in the West, and are found in situations where strip mining is the only practical method of extraction. So the problem is more complex—you can mine coal with less sulfur to control the sulfur problem, but you have to strip-mine it in scenic, semi-arid locations, where it is difficult to re-establish a vegetative cover on the disturbed land. Participants in the Interagency Program, principally EPA and several agencies of the U.S. Department of Agriculture, are now tackling this problem with R&D programs for large-scale revege-

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tation and reuse or proper disposal of mine refuse, so that strip mining can be done in a manner compatible with environmental quality. This effort will be patterned after the very successful interagency demonstrations at Elkins, West Virginia, of reclamation of Eastern U.S. surface mined areas. Here EPA, the U.S. Bureau of Mines, the U.S. Geological Survey, the U.S. Fish and Wildlife Service, and West Virginia state agencies conducted R&D which showed that proper grading, soil modificiation, and seeding can be used on mine spoils to promote revegetation and restore strip-mined land. Land in western coal areas is, of course, far drier than in the east so the reclamation techniques will differ dramatically. The approach to the problem, however, will be similar.

Physical/Chemical Coal Cleaning—Another method of controlling sulfur and other pollutants in coal is to remove them before the coal is burned for energy. This involves some form of washing the coal to remove pyritic sulfur along with stone and other noncombustible constituents (physical cleaning), or chemically converting and leaching out the pyritic and organic sulfur (chemical cleaning). In the Interagency Program, EPA and the Department of Interior have developed and demonstrated several physical cleaning processes. An outgrowth of this R&D is the multi-stream process now being demonstrated by private industry on a commercial scale, at the Homer City, Pennsylvania mine-mouth power plant. In chemical cleaning, the Meyers Process, developed with EPA support, is being tested at a pilot plant with hopes that it will be economically competitive with other sulfur control schemes such as flue gas cleaning.

Direct Combustion—A third way to control sulfur compounds and other pollutants in coal is through a special burning process called fluidized bed combustion. Here coal (or heavy residues of petroleum refining) can be burned on a bed of chemical reactants which remove the pollutants in the process of combustion. With Interagency Program sponsorship, a fluidized bed Miniplant has been constructed in Linden, New Jersey as a test facility. Operating successfully under a full range of conditions, this plant is demonstrating that fluidized bed combustion is a feasible process for using coal while controlling pollution.

Flue Gas Cleaning—A fourth method of controlling pollutants in coal is to clean them from the combustion gases after the coal is burned. Early emphasis in this area was on controlling sulfur pollutants. Extensive projects are presently underway to demonstrate alternative processes to remove sulfur from flue gases. Program emphasis is now shifting to the assessment and control of other pollutants such as fine particles and nitrogen oxides. Such projects are part of an overall program to identify all major pollutants from stationary sources, assess their impacts, and develop technologies to control them where necessary. For several years, demonstration of flue gas cleaning processes has been a major objective of the Interagency Program. Key actors here have been the EPA and the Tennessee Valley Authority (TVA). One of the main problems in controlling sulfur pollutants through flue gas cleaning is the disposal of the waste sludge which contains the sulfur and other pollutants removed from the stack gases. At TVA's Shawnee Steam Plant, methods are being developed both to stabilize these sludges chemically so that they can be disposed of safely, or, alternatively, to turn them into a useable waste product which can be sold. A closely related interagency category is *Thermal Control*, which concerns eliminating not only the pollutants but also the excess heat generated by burning coal and other fuels. EPA and TVA R&D efforts are emphasizing reuse of the heat in industry and agriculture. Such waste heat re-use could dramatically increase the thermal efficiency of these energy processes.

Synthetic Fuels—This fifth area of R&D will allow use of our coal resources by removing sulfur compounds and other pollutants in processes which convert the energy components of coal to clean-burning synthetic fuels. In addition to removing pollutants, synthetic fuel processes promise to produce liquid and gaseous fuels which are in such demand. A number of synthetic fuel processes are in commercial operation in other countries, and their full development here will mean that our coal energy can be used with minimal environmental pollution and that our dependence on foreign oil will be considerably lessened. Agencies in the Energy/Environment Program are advancing R&D through their own research and in support of the efforts of U.S. industry. ERDA and EPA are especially active in this area to ensure that the production of synthetic fuels does not release other substances hazardous to human health and the environment.

Advanced Systems and Conservation—While fossil fuels, and especially coal, are seen as the main near-term energy sources requiring R&D into environmental control, other areas also receive the attention of the Interagency Program. Nuclear fuel cycles continue to cause environmental concern, and methods for disposal of nuclear waste are undergoing assessment by agencies in the Energy/Environment Program. Geothermal and solar energy will not be without environmental impacts, and initial assessments of these effects are nearing completion. Finally, in the area of conservation, much can be achieved to reduce the need for energy (and hence the need for controls) through more efficient energy use. Some of the most successful examples here have been EPA-supported projects in St. Louis, Missouri; Ames, Iowa; and a planned effort in Washington, D.C., and other cities which burn municipal waste with coal or oil (with appropriate environmental controls) to produce electrical power.

SUMMARY

EPA, in its role as coordinator of the Federal Interagency Energy/Environment R&D Program, will continue to pursue the following objectives:

Work toward increased domestic energy development within acceptable social, economic, and environmental limits.

Promote coordination and communication among researchers and managers in all participating agencies.

Employ a simple, common sense R&D planning structure.

Carry out policy recommendations of the Interagency Task Forces.

Schedule energy/environment R&D to support development of the domestic coal reserve as quickly and cleanly as possible.

Future Plans

An open and wide-ranging planning approach is being used by EPA in its role as coordinator of the Federal Interagency Energy/Environment R&D Program. With input from the other participants, EPA concentrates on strategic planning, information assessment and transfer, and preparing a balanced overall program. Detailed program execution and management is delegated to the field laboratories of EPA and to the other participating Federal agencies.

With each annual cycle of fiscal year when the strategic planning phase is completed, EPA's role becomes one of coordinating and monitoring the program. At OEMI headquarters, the specific responsibilities include administration of the Interagency R&D Programs as well as review and communcation.

To identify new priority research needs and provide a major forum for information exchange, "sector groups" have been established for broad energy-related program areas. Under the leadership of the headquarters technical staff, each group is comprised of research personnel, agency officials, and other representatives of participating agencies involved in related research areas. The groups meet every three or four months to ensure that the research needs in each problem area are adequately covered. To date, sector groups have been established for electric utilities, advanced fossil fuels, and western energy resource development.

At the sector group meetings, participants present information on topical areas from their own unique perspectives. Sector group discussions highlight areas of major concern, explore solutions to current and potential areas of unnecessary duplication, and identify emerging areas of R&D opportunity. Information exchanged during these meetings is documented and is used in the fine tuning of ongoing research and in the conceptualization and planning of new R&D efforts.

Early indications are that this planning/implementation structure is a success. It was applied initially to the $134 million FY 1975 and the $100 million FY 1976 program and the planning phases of the $97 million FY 1977 program. Improvements are being made as experience is gained. While such a structure alone cannot achieve the coordination necessary for effective implementation of the R&D program, it provides a sound foundation for a successful program. In any event, continuing cooperation and communication between the participating agencies and their laboratories is required to ensure its success.

Among the complex issues and problems facing Americans as we enter our third century, two things are clear: we must have enough energy to maintain our way of life, and we must ensure that our energy is used in environmentally sound ways to make that way of life more worth living. The Federal Interagency Energy/Environment R&D Program is working to ensure that these two goals are compatible, and that they are being achieved.